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NEOWISE Status

July 21, 2015

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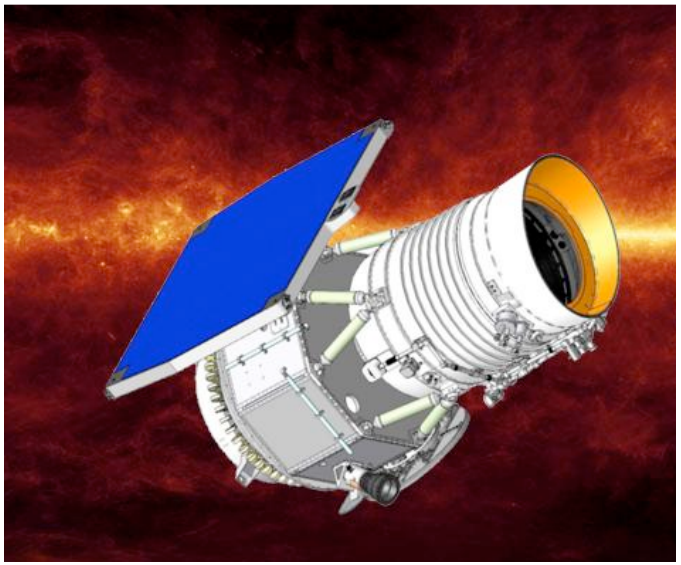
Mission Overview

Salient Features

- PI-led (PI: Amy Mainzer, JPL) mission under NEOO Program (Lindley Johnson, Program Exec)
- Utilizes WISE S/C that was brought out of hibernation in October 2013
- 3.4 and 4.6 μm bands (W1 and W2) at 75K
- Similar observing strategy to WISE/NEOWISE
  - Terminator-following pole-to-pole orbit
  - Surveys entire sky roughly every 6 months
- Science operations: ~3 years starting 12/2013



Science

- Expand the NEOWISE survey of Near-Earth Objects (NEOs) at mid-infrared wavelengths using WISE W1 and W2 channels
- Obtain physical characterization (including diameters and albedos) of these NEOs and the several thousand other small bodies detected by NEOWISE
- NEOWISE observations a key component to future mission planning (both human and robotic)

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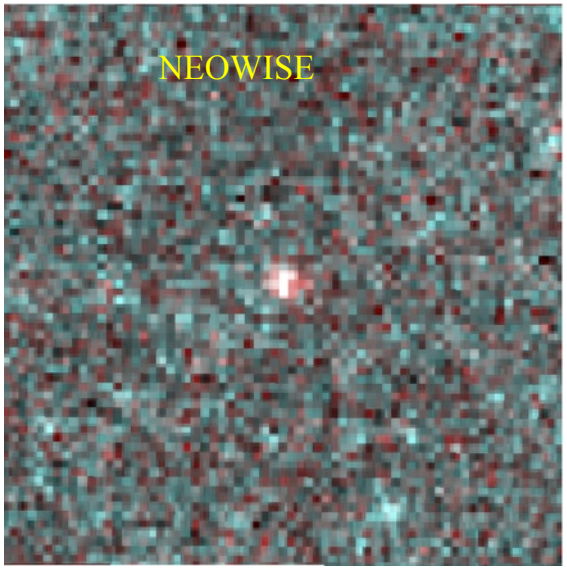
NEOWISE Science Observation Summary

- Since the start of operations, NEOWISE has obtained over **265,000** infrared measurements of **14,034** solar system objects, including **353** NEOs of which **59** are new discoveries
- Recent NEO discovery **2015 KL157** is a PHA with a MOID of 0.003AU (~1 lunar distance), diameter of 0.58km and V albedo of 0.05
- Fourth comet discovery: **2015 J3 (NEOWISE) –** Jupiter family



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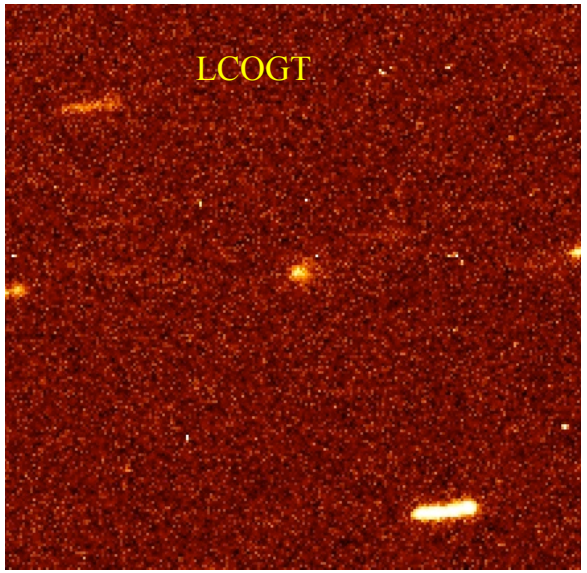

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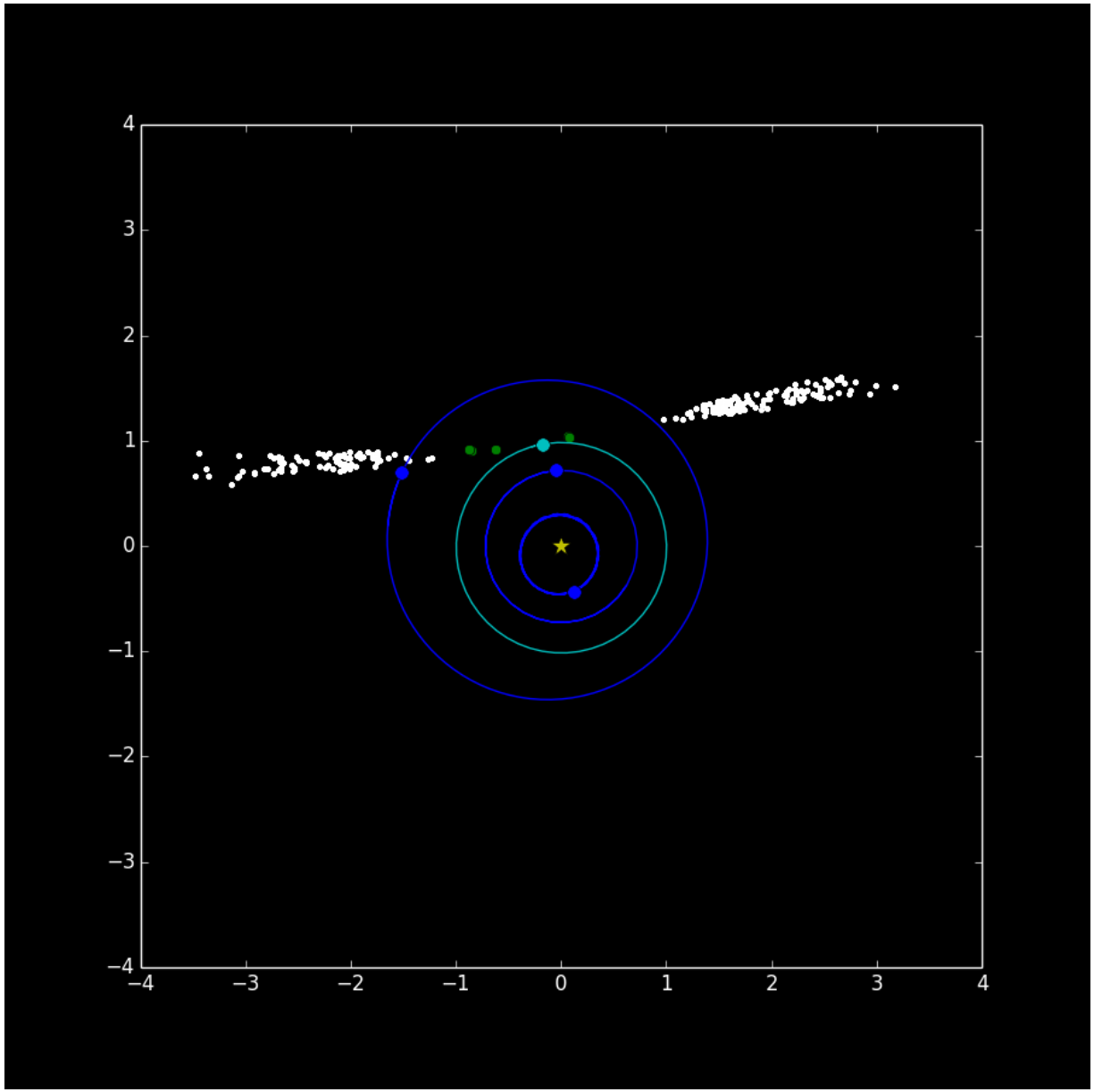
NEOWISE Year 1 Survey



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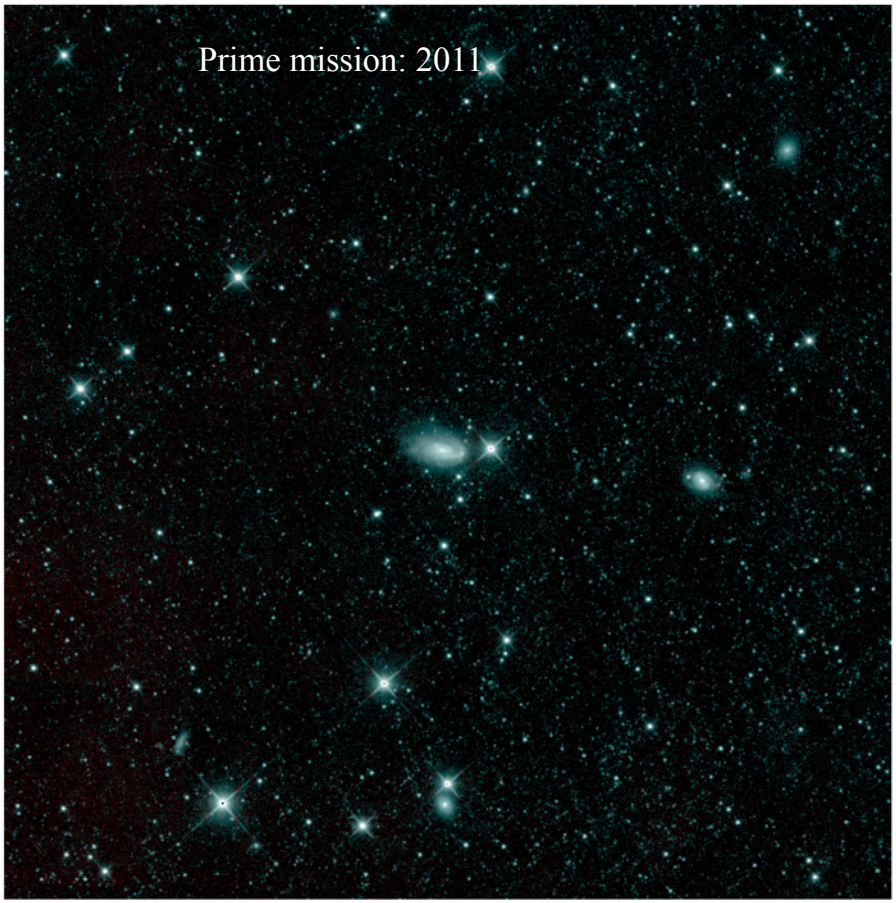
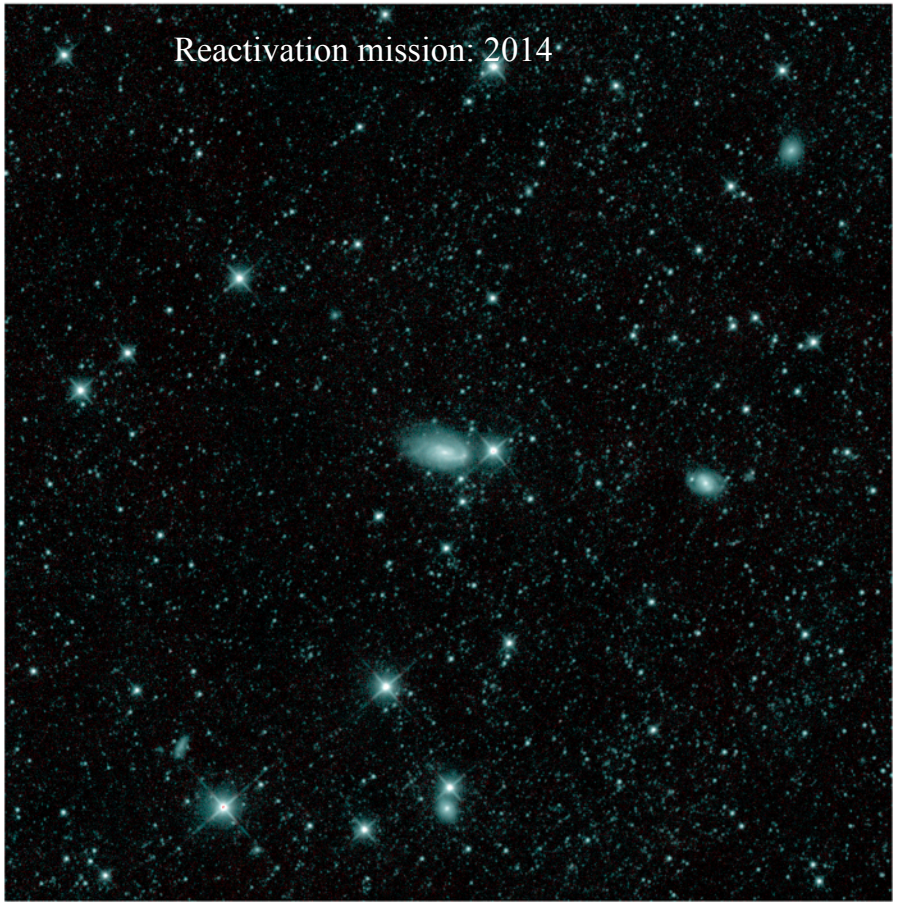
Instrument Performance

- Image quality, photometric accuracy, astrometry, sensitivity all unaffected by 32 month hibernation





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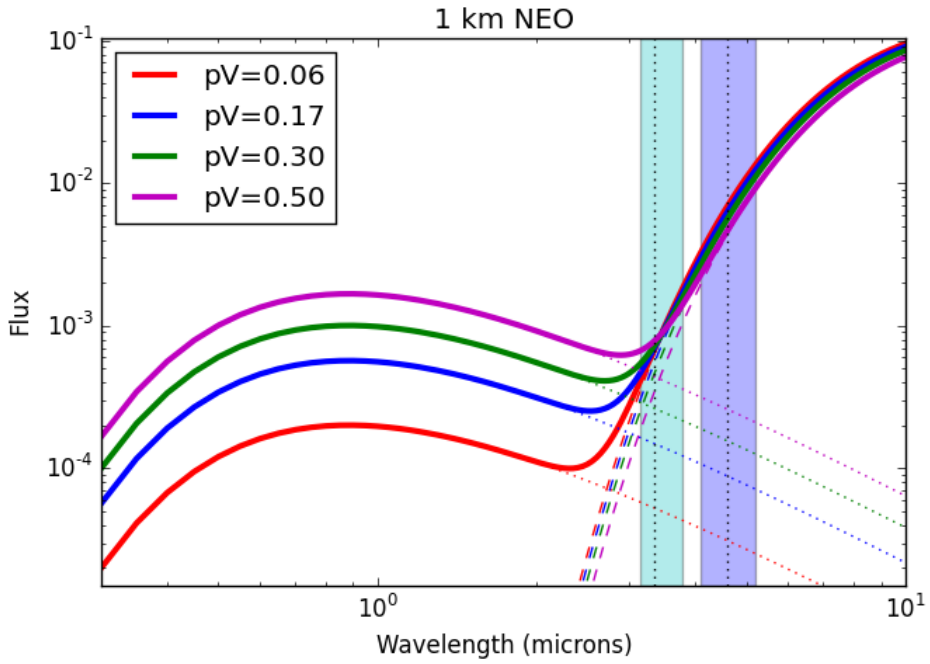
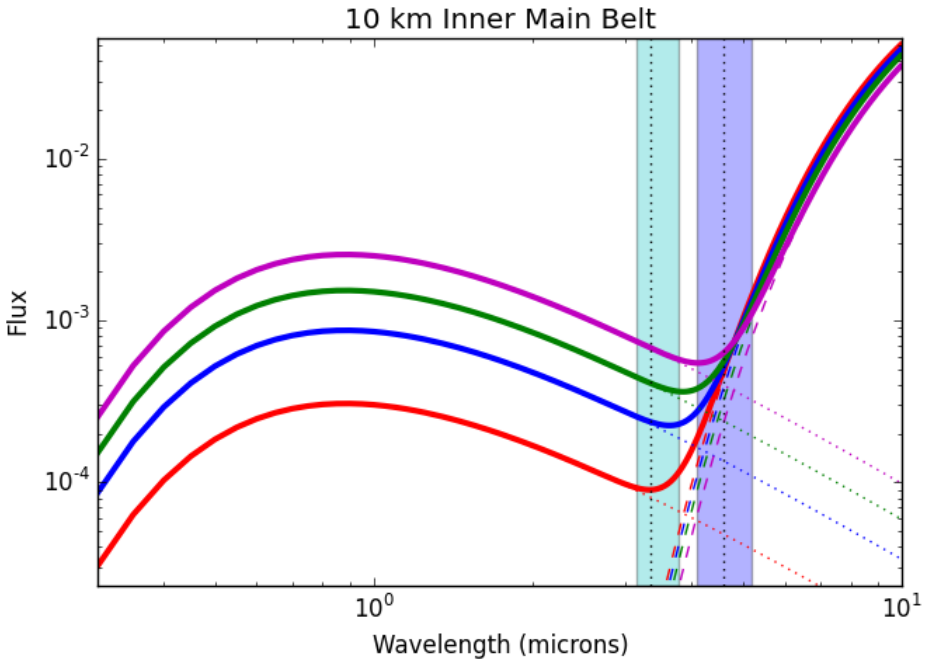
Asteroid SEDs

- NEOWISE provides critical constraints on the thermal emission from NEOs and some MBAs, allowing for measurement of asteroid diameters, and albedos when combined with optical data





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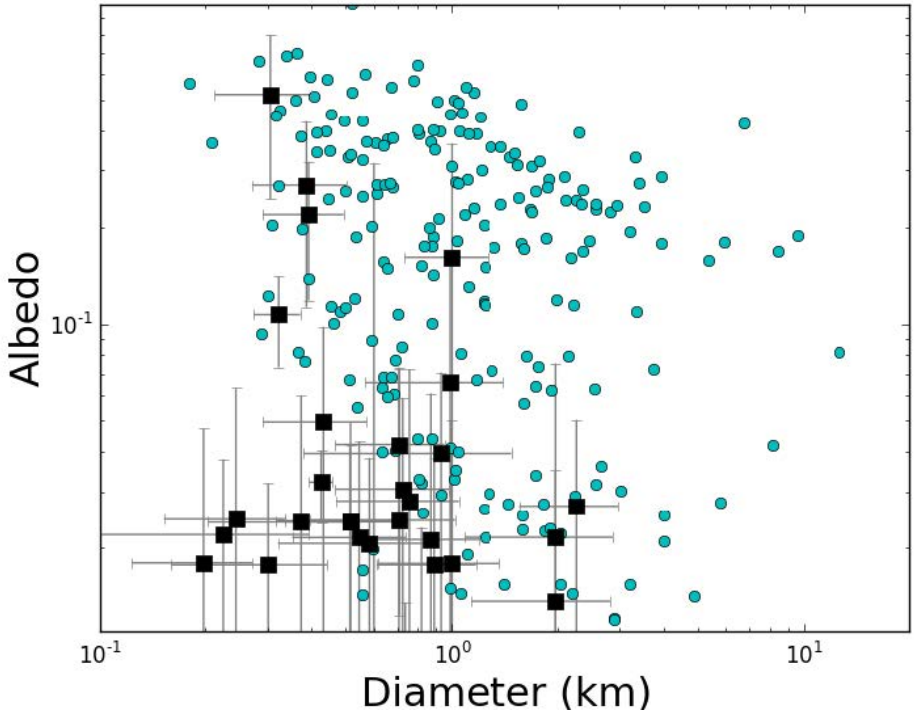
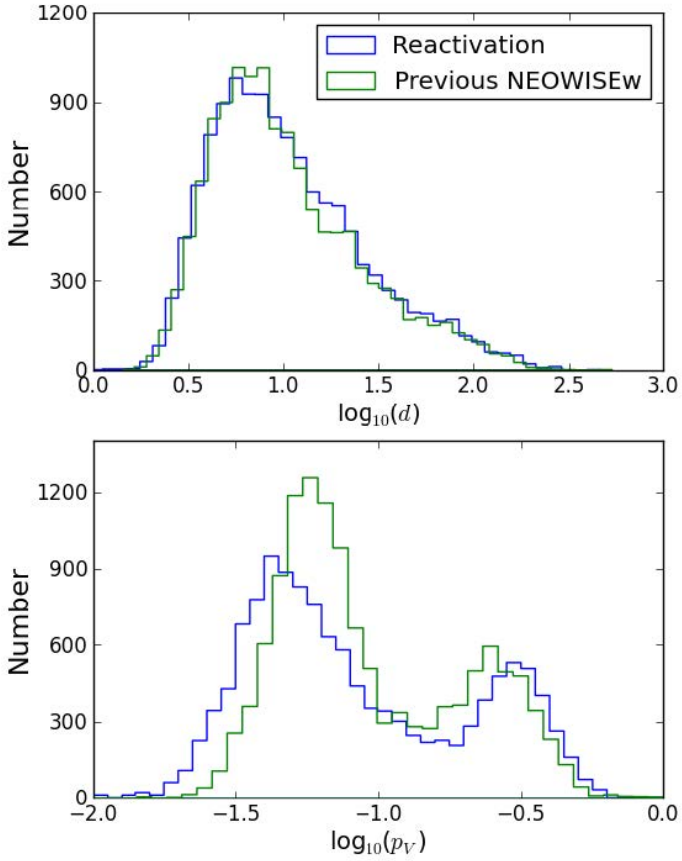
Diameters and Albedos for 9,309 Asteroids Detected During First Year

- Nugent et al. (2015 ApJ, in review)
- Includes 203 NEAs
- Diameters accurate to ~20%, Albedos to ~45%



- NEOWISE preferentially detects large NEOs
- NEO discoveries tend to be dark
- Nearly a quarter are PHAs



Diameters and albedos consistent with values from original NEOWISE mission

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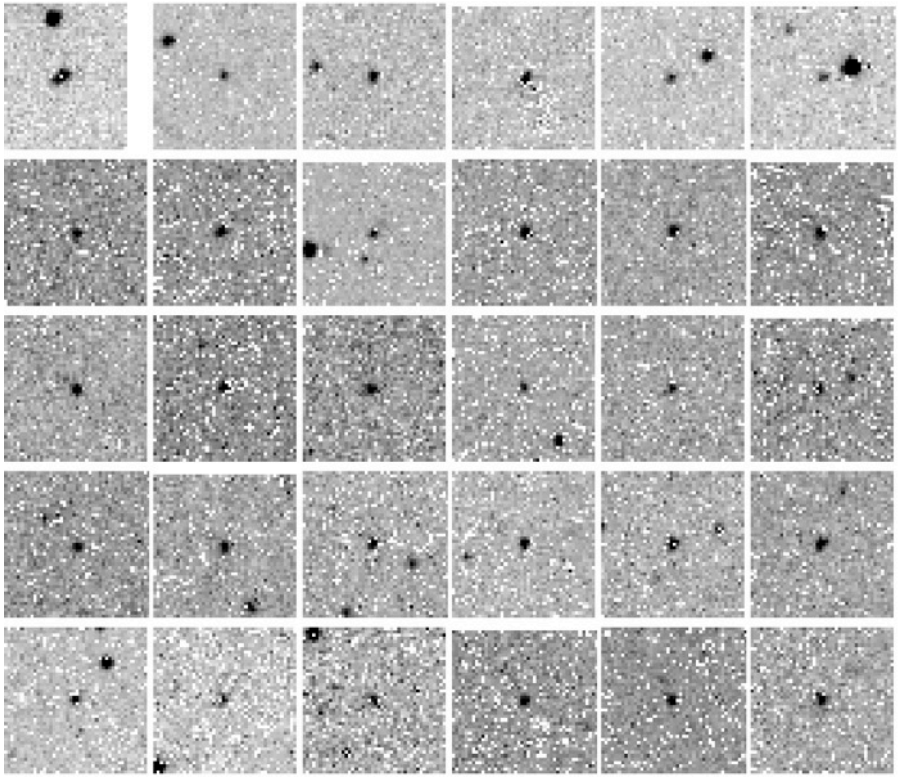
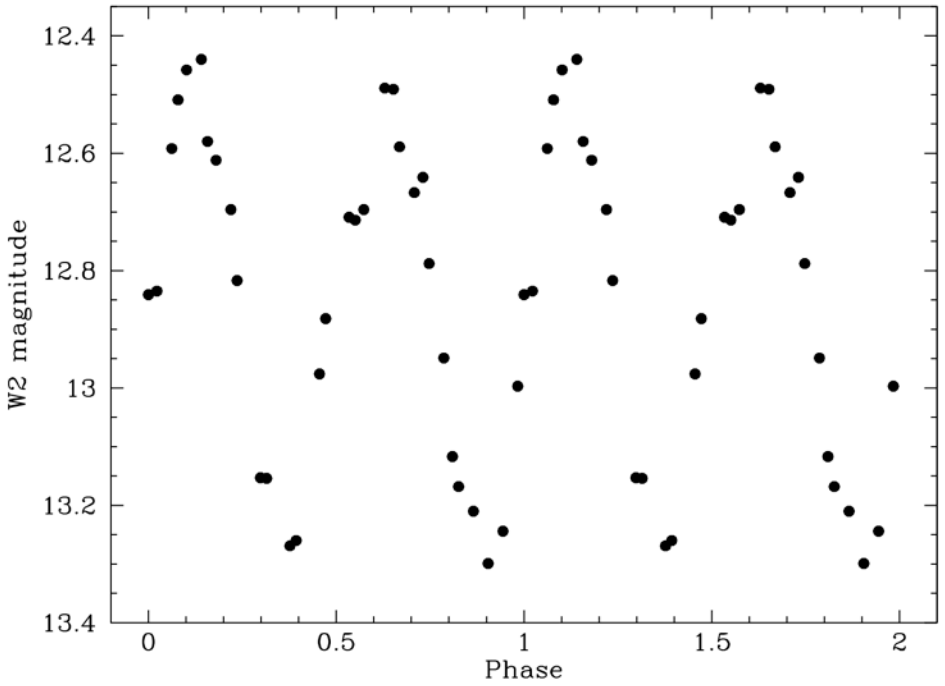
NEOWISE 2015 Data Release
March 26, 2015

http://wise2.ipac.caltech.edu/docs/release/neowise

- **Single-exposure data** from the first year of the NEOWISE Reactivation Mission
- **2,497,867** calibrated 3.4 and 4.6 μm FITS images, uncertainty maps and bit masks
- **18,468,575,596** source extractions (positions and W1/W2 fluxes, ancillary information) from those images
- **Data access**:
  - Image and source database from the NASA/IPAC Infrared Science Archive (IRSA)
  - Moving Object tracklets from the IAU Minor Planet Center

Single-exposure Data: Time-domain Resource for Solar System Object Recovery and Analysis





- W2 Single-exposure Images of NEO 2005 UP156 (2'x2' sections)
- 30 separate observations during 4-7 July 2014 encounter

- NEOWISE year 1 phase-folded W2 light curve of 2005 UP156 using Single-exposure DB photometry (P=40.14 hours)

Single-exposure Source Database Characteristics

		W1	W2
Sensitivity (SNR=10)	**mag**	**15.0**	**13.7**
	microJy	300	565
Completeness (>90%)	**mag**	**15.8**	**14.4**
	microJy	150	300
Reliability (>95%)	**mag**	**15.0**	**13.5**
	microJy	300	680
Astrometric Accuracy	70 mas (high SNR)		

Solar System Search Capabilities at the NASA/IPAC Infrared Science Archive

http://irsa.ipac.caltech.edu

- WISE/NEOWISE data served by on-line and machine-friendly IRSA services
- Solar-system object-specific search functions developed as part of the original NEOWISE program (2009-2011)
- Extended to IRSA's data services for other missions including Spitzer and PTF

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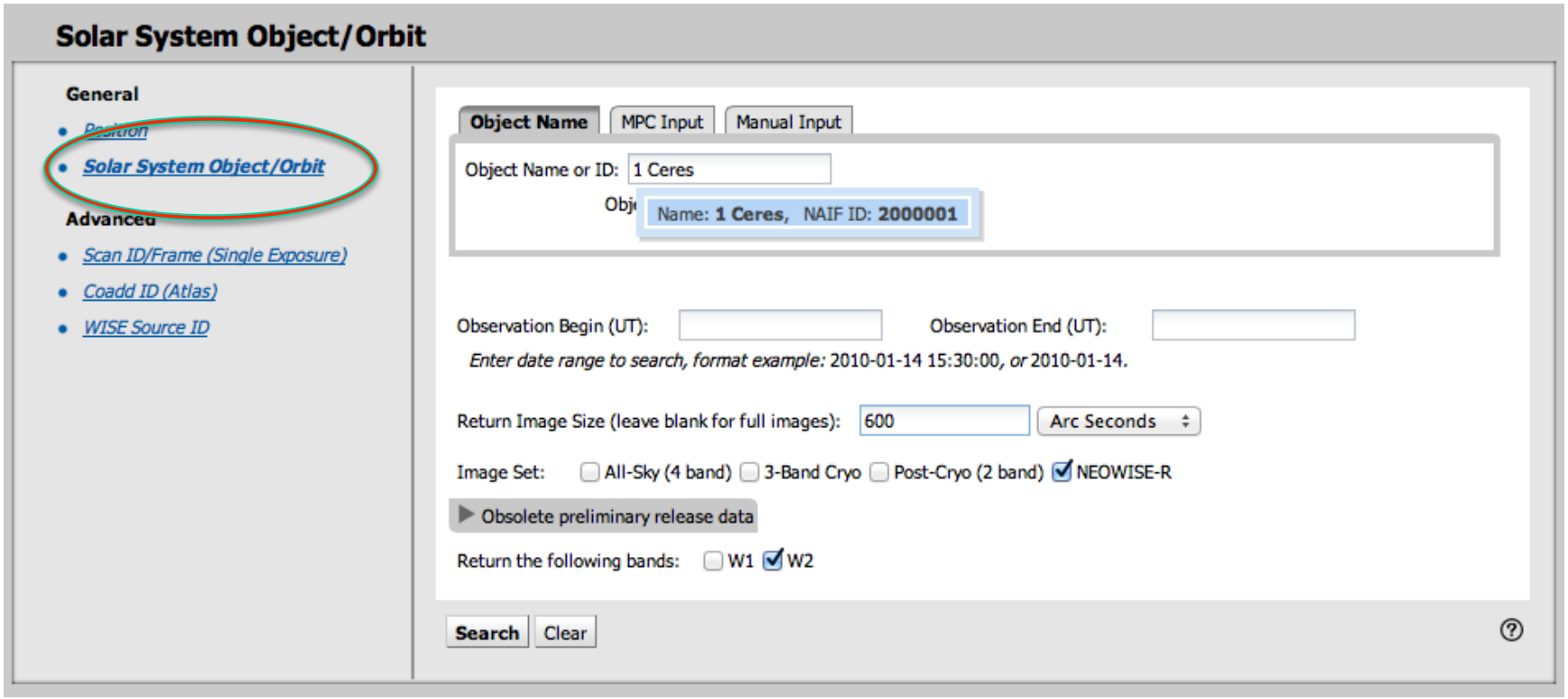
WISE/NEOWISE Image Server: Solar System Object Search



Search for Images that cover the position of Moving Objects at time of observation

- Search by Object Name (Name resolution via JPL Horizons)
- Search using orbital elements with MPC format
- Search using manually input elements

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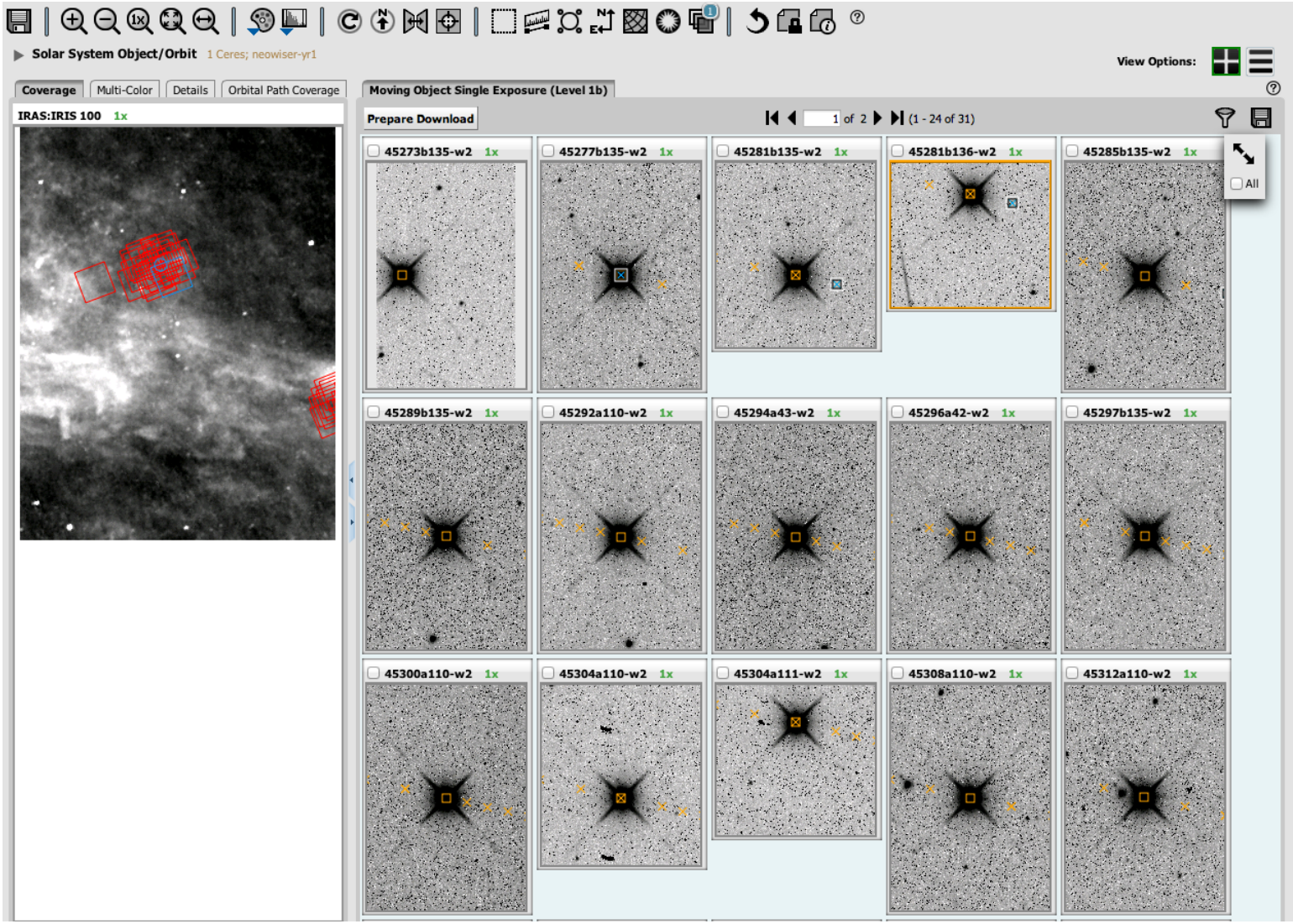
Results of Solar System Search: Grid



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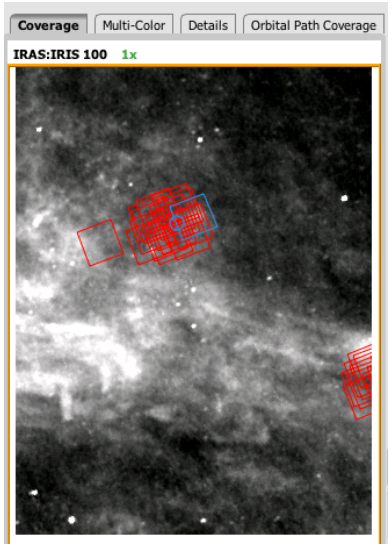
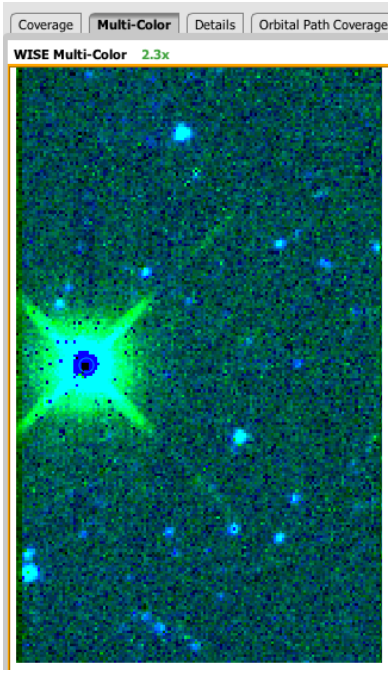
Results

NEOWISE

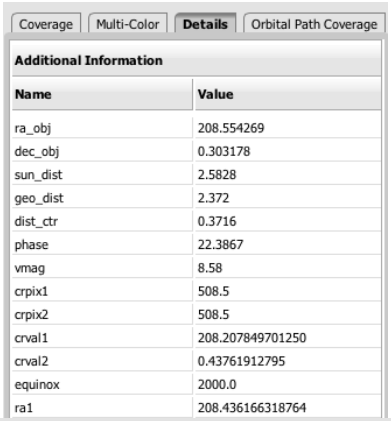
Coverage



Multi-Color

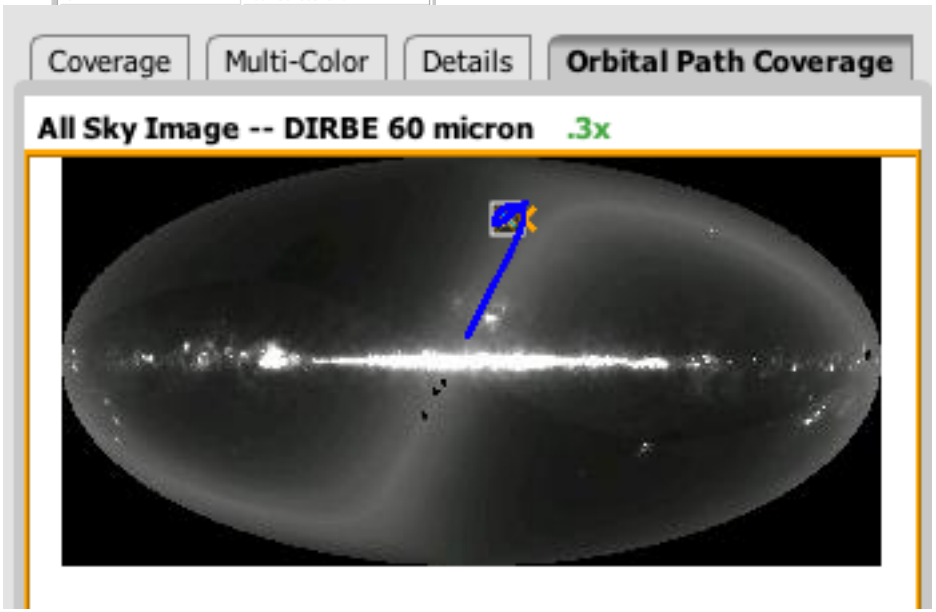


Details



Name	Value
ra_obj	208.554269
dec_obj	0.303178
sun_dist	2.5828
geo_dist	2.372
dist_ctr	0.3716
phase	22.3867
vmag	8.58
crpix1	508.5
crpix2	508.5
crval1	208.207849701250
crval2	0.43761912795
equinox	2000.0
ra1	208.436166318764

Orbital Path Coverage



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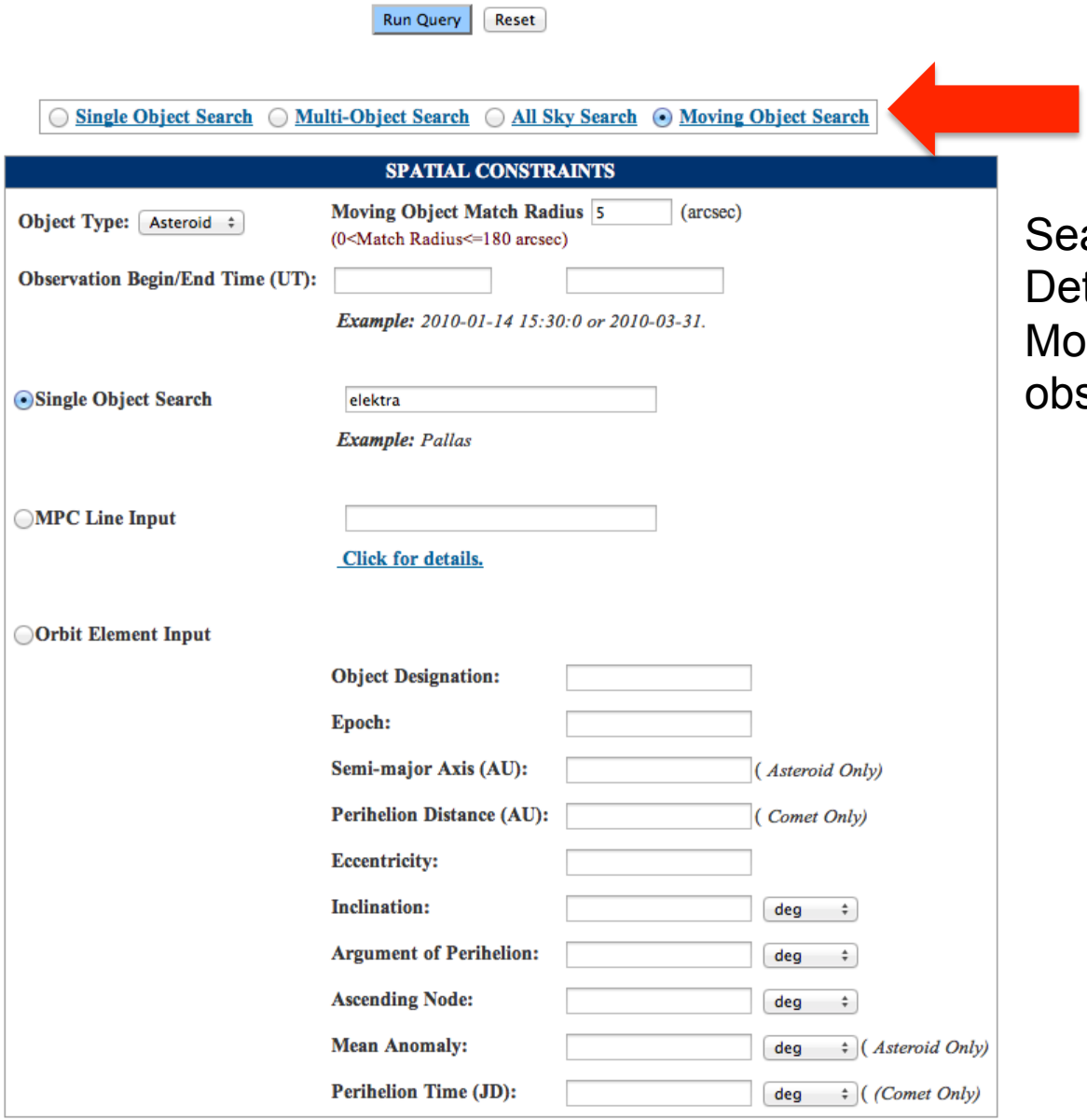
Catalog Query Engine: Solar System Object Search



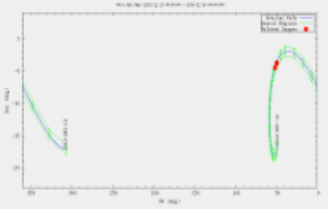
Search Source Database for Detections at predicted position of Moving Object at time of observation

- Search by Object Name (Name resolution via JPL Horizons)
- Search using orbital elements with MPC format
- Search using manually input elements

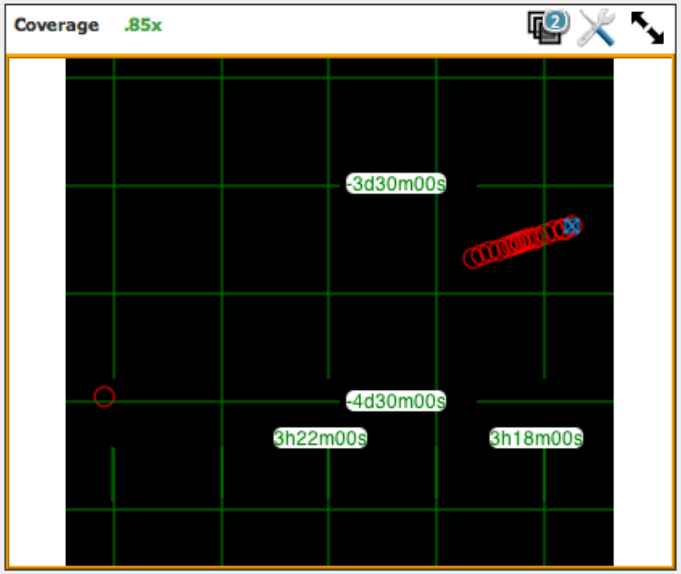
Catalog Search Result for NEOWISE-R Year 1 Single Exposure (L1b) Source Table

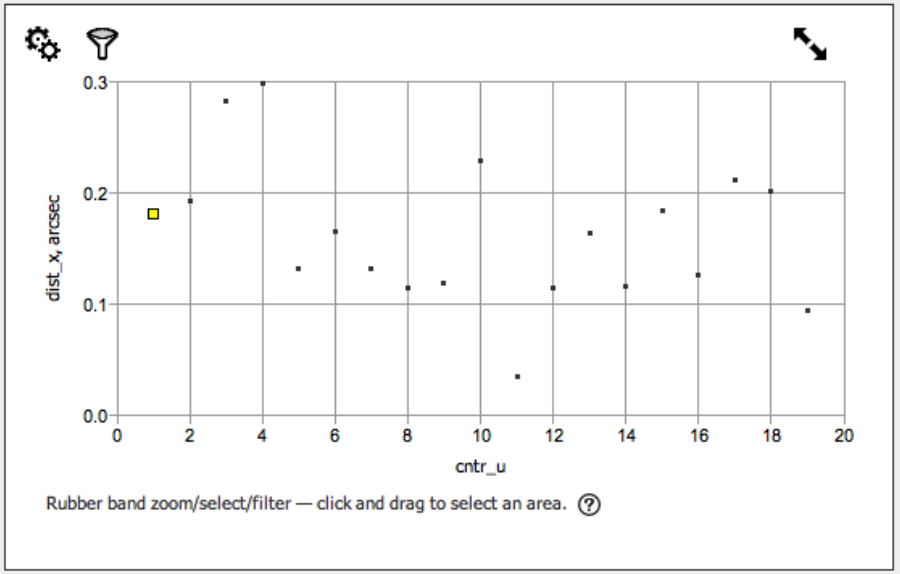
Moving Object		Observation Time	
Type	**Name**	**Begin**	**End**
Asteroid	130 Elektra	2013 12 13 00:00:00	2014 12 14 00:00:00
Designation	**Epoch (MJD)**	**Semi-major**	**Eccentricity**
130 Elektra	56639.00	3.123766383191	0.208587220463
Inclination (deg)	**Argument of Perihelion (deg)**	**Ascending Node (deg)**	**Mean Anomaly (deg)**
22.866505235768	235.628120738519	145.407982878680	317.995810613083

Matched Image List



All Sky Search Constraints: Yes **38 sources found.**





Result IPAC Table **Column Key**

1 of 1 (1 - 19 of 19)

cntr_u	dist_x (arcsec)	pang_x (deg)	ra_u	dec_u	ra (deg)	dec (deg)	sigra (arcsec)	sigdec (arcsec)	sigradec (arcsec)	w1mpro (mag)	w1sig (ma
1	0.180826	40.666238	49.371581	-3.686568	49.3716138	-3.6865299	0.0276	0.0225	-0.0075	10.211	0.014
2	0.192727	16.236655	49.411816	-3.699347	49.4118310	-3.6992956	0.0274	0.0258	0.0039	10.293	0.018
3	0.281305	5.349284	49.411857	-3.699345	49.4118643	-3.6992672	0.0252	0.0226	0.0092	10.308	0.017
4	0.298546	5.108685	49.452031	-3.712170	49.4520384	-3.7120874	0.0266	0.0224	0.0080	10.080	0.016
5	0.130517	-13.854746	49.492144	-3.725041	49.4921353	-3.7250058	0.0262	0.0229	-0.0031	9.905	0.014
6	0.164148	19.429601	49.532194	-3.737959	49.5322092	-3.7379160	0.0252	0.0207	-0.0054	9.956	0.015

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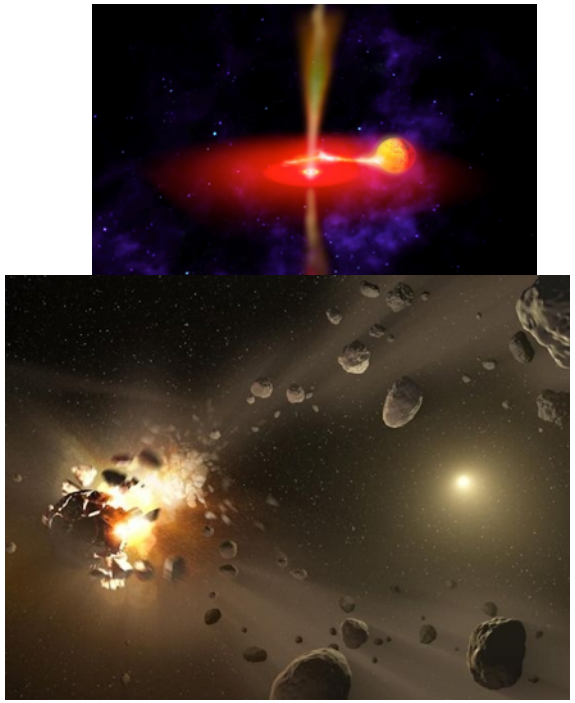
NEOWISE Data Use

- Total citation count using NEOWISE data & discoveries now >200 refereed publications
  - Total citation count for WISE >1400 refereed publications

- NEOWISE is a time-domain mid-infrared all-sky survey, so its science spans many areas of astrophysics & planetary science:
  - Asteroids
  - Meteoritics
  - Giant planet migration
  - Variable stars
  - Icy bodies in the outer solar system
  - Distance ladder determinations for cosmology
  - Human exploration
  - Supernovae
  - Pulars
  - Exoplanets
  - Black hole accretion disks



Conclusion

- NEOWISE is discovering & characterizing small bodies
  - Diameters accurate to ±20%, albedos to ±45%
- Orbital precession will eventually force an end to the mission
- Over 14,000 small bodies observed since restart
- Data access: irsa.ipac.caltech.edu